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Evaluation Of Kinematic Walker For Domestic Duties

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Abstract-Here we are designing a hexapod robot based on the kinematic mechanism with controllers. This robot is interfaced using Atmel microcontroller. It differs from the existing system by the use of two DC motor which helps it to move in any direction. It can move either left or right and also forward or backward. The movement of the hexapod robot is inspired by the characteristics of biological creatures. It is a fully automated robot. Earlier the movement of the hexapod robot was controlled with the help of remote but now it has been made fully automatic.
Keywords- automatic, stability, collision avoidance, Hexapod robot, biological creatures.

I., INTRODUCTION

In the existing system kinematic walker is used to moving in forward and backward direction only, which makes it less efficient and difficult to use in natural terrains or for any purpose. The hexapod robot works on the kinematic mechanism which is a six-legged walking machine capable of operating in a complex natural environment rather than machines with wheels. To achieve the degree of adaptability of locomotion even through rough terrains, we use this hexapod robot. This robot has better stability when compared with others. Earlier the movement of the robot was only forward and backward but now it is possible to move even left and right. By the combination of two kinematic walkers. It is also capable of sensing the obstacles and avoiding collisions. Detecting the obstacles is one more advantageous criteria in using this hexapod robot.

II. SPECIFICATION

2.1 Dc Motor

We make use of two DC motors for the movement of the hexapod robot. A DC motor usually consists of six basic parts such as an axle, armature, stator, commutator, field magnets, and brushes. The advantage of using a DC motor is that it provides a good rpm(rotations per minute) and it does not require a minimal amount of supply voltage.Since we use this robot for domestic purposes only, it does not require high-speed motors and it is also cost-effective when compared with others. It has the capacity to withstand a maximum range of current that is being carried by the circuit without damaging the circuit itself. Due to all these advantages, we go for the use of DC motor.

The internal mechanism of DC motor is to balance the magnetic interaction between the current carrying conductor and an external magnetic field that provides the rotational motion.

2.2 Relay

Relays are basically used to control the motor used. It can act as an electromechanical switch as well. A relay is generally made up of electromagnets. Many devices make use of relays. It has 4 parts in it, they are electromagnet, armature, spring and a set of electrical contacts. The major operation of a relay is ON or OFF. To perform OFF operation, no voltage is supplied to the coil. Therefore no magnetic field is induced and the switch is opened thereby no current is passed through the relay and the motor is in OFF state. Now to perform ON operation, voltage is being supplied to the coil. It induces magnetic field thereby the switch is closed and allows current to pass through making the motor to turn ON. This relay is controlled by a pair of switching transistors, Q1 and Q2. The relays which we have used are 12volts. From the below diagram, the load represents the motor used. Four relay circuits are required. One relay circuit controls both the forward and reverse movement. The second relay controls both the right and left movement. Third relay circuit controls the water pump. The fourth relay controls the water valve to open and close the water supply.

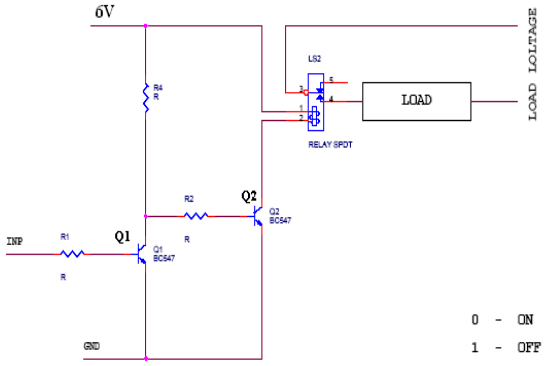

Fig 1: relay circuit

2.3 Microcontroller

The next device used in the circuit is the microcontroller. A microcontroller basically integrates many microprocessors into a single chip. It has many inbuilt components which itself makes it a mini computer. The microcontroller that we use for this hexapod robot here is ATMEL microcontroller that is AT89S52.This microcontroller is used for various embedded applications. The codes are dumped into the microcontroller for the proper functioning of the hexapod robot.

AT89S52 is an 8-bit microcontroller. It has in-flash memory management system. It consumes less power and performance is high when compared with the other microcontrollers. It operates statically at a rate of 0 to 33MHz. The operating range of AT89S52 is 4 to 5.5V. Here the microcontroller used consists of four ports such as port 1, port 2, port 3, port 4 respectively.

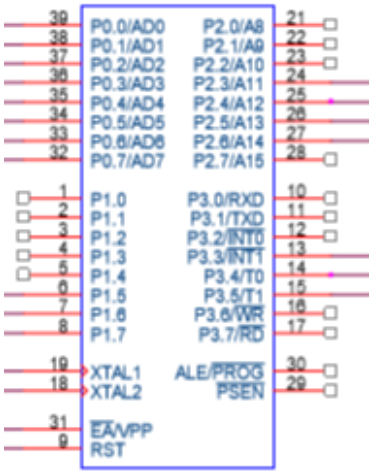

Fig 2: Atmel microcontroller AT89S52

The port 1 is given to the first two relays which is responsible for the forward, backward and right, left movements of the hexapod robot including the ultrasonic sensor and the IR sensor. The port 2 is given to the third relay circuit which is responsible for the proper functioning of the pump. The port 3 is given to the fourth relay circuit which is responsible for the functioning of the valve. The port 4 is an empty port. LCD display is also connected. The codings to operate this robot is booted inside the microcontroller which later controls all the other devices that are used in this bot.

2.4 Lcd Display

The Liquid Crystal Display is an electronic seven segment display module. Nowadays such modules are much preferred rather than multi-segment LED. This LCD is mainly used to display the values and the operation that is currently taking place which can be changed with the help of coding. The content to be displayed will be changed on a timely basis. It consists of two registers namely Command register and Data register. The command registers store the instructions that are given to the LCD through coding.

The construction of LCD is very simple because it consists of 2 glass of panels and the material called the liquid crystal is sandwiched between those two glass panels. To maintain the defined orientation angle polymeric layers are

present in between the electrodes. In off state rotation of the light rays are due to the two polarizers and the liquid crystal in order to avoid any changes in the orientation of the light ray along its path. The crystal molecules of the Liquid crystal display gets aligned in a particular direction when the sufficient amount of supply voltage is applied. The polarizers are responsible for rotating the light that is passing through the electrodes thereby activating the desired characters. The thickness is only a few millimeters. The LCD is not capable of producing light on its own, so light is needed for reading the desired characters that appear on the display of the LCD monitor display. In this, the LCD display is one of the major components because it is used to understand whether the movement of the hexapod robot is in the required direction and it also indicates when the robot stops and initiates its movement. Backlighting phenomenon is used to read the characters in the LCD monitor display.

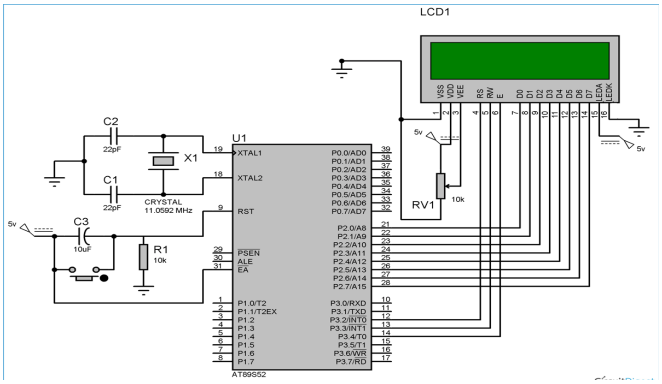

Fig 3: LCD interface with AT89S52

The above diagram shows the LCD interface with the Microcontroller.
The transistors are also used in designing the circuit. The different transistors are the NPN and PNP transistors. For npnNPN transistors if it is high then the circuit is in on state and when it is given low it is in off state. A PNP transistor is the opposite of the NPN transistor wherein low denotes that the circuit is in on state and high denotes that the circuit is in off state. A transistor can act as an amplifier or a switch.

2.5 Ultrasonic Sensor

The ultrasonic sensor is used for converting the electrical energy into sound energy. Sound waves above the normal range of human hearing which could be greater than 20 KHz can be considered as ultrasound. In this, the ultrasonic sensors are used to avoid the robots from hitting an obstacle in their path.It consists of transmitter and receiver inbuilt within the chip. The electrical supply given to the transmitter converts it into sound energy. The transmitter transmits a particular range of frequency waves for a continuous period of time when it encounters an object then the receiver receives echoes. The received echoes are calculated to find the distance between the bot and the object which is sent as signals to the microcontroller to stop the bot and avoid it from a collision. The supply voltage is 5V and the supply current is 30mA. It is similar to the working principle of radar and sonar.

2.6 Power Supply

The power supply is essential for all the electronic circuits to work. The components of the typical power supply are the AC input line, AC line filter, Transformer, Rectifier, Filter, Regulator and DC-DC converter. The main function of the transformer circuit is to step up or step down the AC voltage level. The rectifiers are used for converting the AC sine wave into pulsed DC wave. Generally, the rectifiers are made up of diodes. There are two types of rectifiers namely the half wave and the full wave rectifier. The half wave rectifier generates only one pulsating sine wave for each and every cycle of the input pulsating sine wave. The diode is forward biased when the sine wave is positive and also the anode of the diode is also positive. The diode starts conducting and appears as a closed switch. In reverse biased condition the diode will be in negative and no current is produced in the circuit. During the negative half cycle, the load voltage will be zero. A filter is used to prevent and also to remove any fluctuations and also to produce constant output. An example of the most commonly used filter is the large capacitor. By connecting a large capacitor across the load resistor, it filters the pulses into more constant DC. Regulators are most commonly IC's. Regulators are used to holding the desired output value.

III. FABRICATION

For the making of this robot, we used metal sheets as legs thereby giving it a sharp edge leg to support them move in ease at rough terrains. The other components used in the making are supporting leg, center rod, main bar, sprocket and main leg. The supporting leg was also made up from metal sheets bolted together to give a thick supporting base. The main bar was used to join the supporting legs and main legs for proper movement. For the movement of the walker, gears and chains were used. The gears were attached to the walker and the motor through welding, thereby controlling the movement of the legs which can either be in forward or reverse direction. The dimensions of the center rod are 300mm length with 10mm diameter, supporting leg of 45mm length 25mm breadth and 5mm thick. The dimensions of the main leg are 300mm length, 25mm breadth, and 5mm thick.

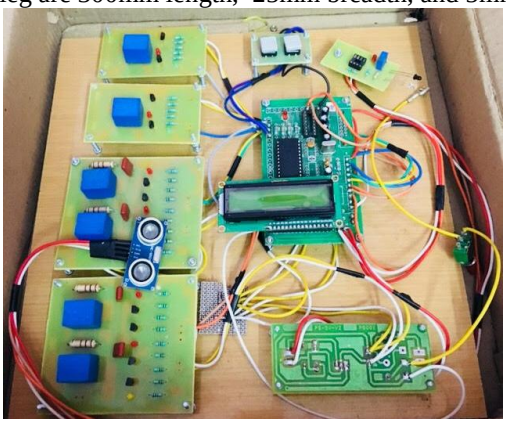

Fig 4: hardware kit of kinematic walker

Fig 4 shows the connections with the microcontroller along with the relay circuits, switch circuit, power supply circuit, signal control unit. This is interfaced with the kinematic walker and with the help of Keil uVision5 thecodings are done and installed to AT89S52.

Fig 5: kinematic walker

IV. OPERATION

This robot was inspired by the movement of crab. Their legs are bent in the outward direction which makes them move in sideways similar to the existing kinematic walker which contains only single DC motor and thereby moves only in forward and reverse direction so to overcome this we have used two DC motors which is one of the specialties of this robot. It is a combination of two walkers with separate motors. In order to make the robot turn right or left, one motor has to stop so that the other makes it move in the desired direction. Since we use two kinematic walkers, we require separate DC motors for its movements. These DC motors are controlled by the microcontroller.

Fig 6: Full kinematic walker with water tank

From the Fig 5, we have made use of water tanks placed in-between the two walkers thereby balancing it. The water tanker sprays the water in three directions according to the readings from IR sensor. Which will make it useful in fire-fighting application as well for cleaning the roads on a daily basis.

With the help of sensors, the robot gets the input. We are using an Ultrasonic sensor for object detection. So as the robot moves in the forward direction when it encounters an object then it immediately stops and turns towards the right, checks if any obstacle is present and moves forward. If in case there is an obstacle in right then it turns over 180 degrees left. The main advantage is that for movement it has legs rather than wheels so that it can move in any terrain. It can also cross any hurdles with ease. Since it is fully automatic no manpower is required to control. It is also monitored through a webcam that is placed over the robot. This can be used for search and rescue purposes too.

V. CONCLUSION

It can be used for several applications since the complete mechanism of this robot is automatic such as search and rescue with the help of cameras, to put out forest fires as its dangerous for humans to go deep interior regions of forest, to take surveys of animals present in forest regions, it can be used in industries for cleaning the machines on a regular basis so that errors done by manpower can be reduced, it can also be used for cleaning the roads including the platforms at ease without the help of manpower.

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